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ABSTRACT

A study of the babbling and phonological development of 54 infants used half-hour videotape recordings of the children at play in their own homes. The vocal output was phonetically transcribed twice for interrater agreement, and analyzed for the consonants used five times or more in the child's vocal repertoire. These consonants were considered to be in the subject's voluntary control. The controlled phones were rank-ordered for their frequency by age, and the mean numbers of phones for each age were computed. For the group as a whole, the most frequently controlled phones were /d/ and /h/, occurring in about two-thirds of the subjects. The second most frequently controlled consonants were /m/, /b/, and /g/, occurring in 41-44% of the subjects. The last group of segments with notable frequency included /n/, /w/, and /j/, occurring in about a third of the subjects. The remainder of the consonants showed sporadic or near zero occurrence. No sex differences were found in the data. The major trend observed was consistency in the place and voicing features of articulation in the first consonants exhibited in the age range. However, there were individual differences in the selection of which voiced front sound characteristics were used and broad differences in the manner of production. Less consistency is apparent in the choice of low frequency consonants. Substantial consistency with the results of previous research was found. (MSE)

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Consonantal Characteristics of Babbling From Eight to Sixteen Months

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Portions of Data From This Investigation Were Presented at BOSTON CHILD LANGUAGE CONFERENCE, 1984

Phonological development has been the focus of theoretical and empirical studies for a century (Humphreys, 1880; Jakobson, 1941/1968; Leopold, 1947; Lewis, 1936; Oller, 1976; Smith, 1973; Stark, 1980; Velten, 1943; Vihman, 1976). Despite the long history of phonological study, methodological and theoretical trends have limited the development of coherent normative information. Recent research demonstrating the phonological continuity between babbling and early speech provides a strong rationale for normative description of the babbling period. The work reported here contributes to this goal by describing consonantal repertoires in the 8 to 16 month age range.

Ingram (1975) has divided the research on child phonology into three historical periods, each characterized by the method of data collection that dominated the period (although not the sole method employed) and the dominant theoretical view of that time. The Period of Diary Studies (1876-1929) was mainly concerned with observing single children through the babbling period; however, the usefulness of the early data is questionable due to unacceptable transcription guidelines.

The Period of Large Sample Studies (1930-1957) was characterized by cross-sectional studies that attempted to develop norms for language acquisition. While several studies (Poole, 1934; Templin, 1957; Wellman et al., 1931)

gathered mass data on phonological development in young children, only Irwin and Chen (1941-1948) attempted to quantify phonological acquisition during the prelinguistic or babbling period of infancy. Perhaps one of the reasons that similar studies were not undertaken was the rapid acceptance of Jakobson's (1941) theory of discontinuity which claimed a lack of relationships between babbling and subsequent "real" words. Another situation which may have contributed to a decline in segmental incidence studies was a growing awareness of the inadequacy of live transcription.

The Period of Linguistics Studies (1958-present) has seen a shift in emphasis from universalism and from competing theories of phonological development to linguistically-oriented longitudinal research which recognizes the importance of individual differences in phonological development (e.g., Bloom, 1970; Ferguson and Mack 1982). See Yeni-Komshian et al. (1978) and Locke (1983) for a review of current literature on phonological development.

Individual differences have been found in all areas and at most levels of development. In phonological development, emphasis has been on the transitional period between late babbling and early lexicon as well as on individual patterns of use of phonological simplification processes in early phonology (De Boysson-Bardies et al., 1982; Oller et al., 1976; Vihman et al., in press). In addition, there has been a trend in research to discover early phonological characteristics or patterns which might serve as precursors

to and/or predictors of later phonology and ultimately of language development in general. However, before the importance of individual differences can be appreciated, normative data are needed concerning patterns of phonological acquisition.

In order to uncover precursors or patterns predictive of later phonological development, it is necessary to examine segmental and suprasegmental skills in infancy. Waterson (1971) has looked at the development and use of intonation contours in infants and toddlers. Many of the "cry" studies have looked not only at intonation, but also at pitch, intensity and duration of cry and comfort vocalizations (as well as of vegetative vocalization). Several investigators (Ling and Ling, 1974; Roe, 1975; Smith and Oller, 1981) have measured the amount of infant vocalization and have calculated percentage of vocalization to non-vocalization time as well as percentage of specific types of vocalization although not specific phonemes. Acoustic analysis have addressed the presence and/or absence of various vocalic segments at a given point in development (Buhr, 1981; Ling and Ling, 1974; Oller and Smith, 1981; Stark, 1976). Recently, Gilbert and Zawadski (1982) presented an analysis of vowel formant frequency progression over time in infants.

Several investigators have examined phonological development from an anatomical and physiological perspective following the lead of McCarthy's (1952) organismic interpretation of phoneme emergence in infants and toddlers

(Ferguson and Falwell, 1975; Glazewski, 1982; Oller, 1980; Stark, 1980). Several studies have examined the frequency of consonantal elements (Ling and Ling, 1974; Oller et al., 1976; Smith and Oller, 1981) but have not considered specific consonants or phonemic elements. However, Oller et al. have "obtained evidence that babbled utterances are not merely random vocalizations but rather a systematic expression of many of the same basic phonetic preferences which have been shown in later childhood pronunciations of adult words and in certain phonological universals of adult languages." (1976, p. 2). Overall, few have studied consonantal segment or phonemic development in infants since the early incidence data of Irwin and Chen (e.g., Blount, 1970; Cruttenden, 1970; Pierce, 1974, and Winitz, 1969).

The study reported here examined and quantified the appearance of discrete phonemes in the vocal repertoire of infants between the ages of eight and sixteen months. Subjects were selected in this age range because of certain developmental changes first apparent during this period. The CV and CVCV utterances of babbling become more syllabic and speech-like in their timing (Oller, 1980; Stark, 1980) and begin once more to increase in number following a decrease (Nakazima, 1975; Roe, 1974). They also become more "communicative" (Locke, 1982; Stark, 1980) as the child no longer vocalizes merely as a circular reaction or practice behavior but begins what Nakazima (1975 and 1980) refers to as the "reorganization process of babbling." The main goal

of this study was to determine whether systematic sequences of consonant development characterize the period of transition from babbling to words.

The present study follows from recent work documenting the relationship between babbling and later language development (Oller et al., 1976; Vihman et al., in press). The data have been analyzed in a manner appropriate for comparison with Irwin and Chen and will be discussed in relation to previous studies which have documented occurrence of consonantal segments in the repertoire of infants in the age range of our sample. Since the Irwin and Chen report, based on live transcription, no study has been conducted which attempted to re-evaluate their findings on the basis of more modern techniques, in particular the use of a tape-recorded data base and coding decisions based on high inter-rater agreement.

METHOD:

The data presented in this study were gathered as part of a larger cross-sectional investigation of language development at the Rutgers University Play Project. The data base for the present study consisted of 54 half-hour video recordings using a Sony 3400 PortaPac and a separate high fidelity microphone.

Subjects:

The children who participated in this study were 54 normally developing male and female infants, six subjects at each monthly interval from 8 months to 16 months of age. They were equally balanced by sex and unselected for socioeconomic status. Each subject was within a week of his month-age at the time of data collection and was determined to be developing normally on the basis of the Bayley Scales of Infant Development (Bayley, 1969). Children studied were obtained through newspaper advertisements.

Procedures:

Mother and child were visited at home on two occasions. The first was to familiarize the child with the examiner and to administer the Bayley Scales of Infant Development. During the second visit, mother and child sat on the floor and a bucket containing a standard set of toys was placed near them. Mothers were instructed to let the child take the lead in play and converse normally with their children; no elicitation procedures were included. A thirty minute play interaction was videotaped.

Transcription:

Critics of consonantal incidence studies in child phonology have questioned the application of the adult consonant system for analysis of infant vocalization. However, in order to understand the child's acquisition of adult phonology, some approaches are needed to quantify the early stages. In the present study our goal was to assess the infant's approximations of adult targets. The best available system to accomplish this was phonetic transcription. This study was limited to investigation of consonantal elements; for recent treatments of vocalic elements see Gilbert and Zawadski (1982) and Pierce (1974).

The first phonetic transcription was done by one member of a team of three advanced graduate students in Speech Pathology under the direction of the first author. For each child, all of the vocal output was transcribed. While vowel vocalizations were not always transcribed, they were included in calculating the total number of vocalizations. The criterion for achievement or productivity of a phone was five separate occurrences, a definition which was chosen for two reasons. First, the investigators wanted to be sure that the consonantal segment being credited was under the child's voluntary control. In addition, since it is difficult to distinguish discrete phones in young babies, by having a criterion of five observations of a sound it was less likely that designation of voluntary control was due to errors in

identification on the part of the transcriber.

A second phonetic transcription was done independently for five children by each of the team members. Among the inter-coder agreement parameters recorded and calculated were occurrence of specific consonants and total number of vocalizations. When these 15 transcripts were compared with one another, reliability along these parameters reliability ranged from .90 to 1.00 with a mean of .95. While the adequacy of videotape for phonological study may be questioned, the high agreement attained suggests that the recordings were adequate. Frequent positioning of the children toward the camera and careful placement of the external microphone, as well as use of a zoom lens on the camera, and use of an auxiliary high-fidelity microphone all facilitated transcription.

It should be noted that /h/ was included in the frequency count of consonantal elements because of its high rate of occurrence and its easy identification as an intentional vocalization. The glottal stop (/ʔ/), on the other hand, was excluded from this study as it often occurred as an effort sound, based not on intentionality of production but solely on physical and physiological positioning of the child. We observed that babies in prone position use many more glottal attacks than do babies in supine or sitting positions. Also we found that younger sitting babies used more than the older babies, probably since the latter demonstrate more advanced motor development.

RESULTS:

For each subject, transcripts were examined to determine which consonants (the terms consonant, phone and segment will be used interchangeably) occurred five or more times in their vocal repertoires. These consonants were considered to be under the subject's voluntary control and the number of consonants so controlled was designated as the competence level for that subject. The phones thus identified for each subject are presented by age in the rank order of their total frequency of occurrence in the sample in Table 1. The mean number of consonants controlled by the six subjects at each age are noted on the bottom of the table.

For the group considered as a whole, the most frequently controlled phones were a voiced, front stop /d/ and a voiceless, back continuant /h/. These sounds appeared productively (i.e., occurred at least five times) in the segmental sound productions of 36 (67%) and 33 (61%) of the fifty-four subjects.

The second most frequent set of consonants noted were /n/, a front, voiced nasal continuant which occurred in 24 children over the sample (44%), /b/, a front, voiced stop observed in 23 repertoires (43%), and /g/, a back, voiced stop which appeared 22 times (41%).

The last set of segments representing a notable frequency of occurrence consists of a front, voiced nasal continuant /n/ (31%) and the two existing glides, /w/ (33%) and /j/ (31%). These latter two sounds are voiced, and both glide off initial front vowels.

The remainder of the consonants exhibit either sporadic or near zero sound unit occurrence.

The single general trend indicated by the data is for voiced, front consonants to predominate in children's early sound repertoires. There is no preference for manner of segment production, i.e., continuant, stop or glide. The phonetic characteristics of the most frequent consonants are summarized in Table 2.

Figure 1 represents the mean number of phones controlled over time. There is growth over age. However, while inspection of Figure 1 indicated a cubic trend there is in reality a linear trend with a low inflection point at 12 months and linear growth thereafter. In addition, there were no sex differences in the data and no differences by age between particular ages.

In order to consider a possible developmental order of consonant acquisition, the consonants controlled at each age were noted and compared. Table 3 represents the specific phonetic units that appear consistently in three out of six of the children's repertoires at each age studied. While no overall consistent order of acquisition of specific consonants is immediately apparent, one is able to view

acquisition or appearance patterns in the data in the following manner.

Examining Table 3, a rough order across age can be seen: /d, h, m, b, g, w/. The predominance of voiced, front consonants is again apparent. In terms of specific consonants used, at every age except 13 months each child demonstrates /h/ in his/her repertoire. Similarly, beginning at 9 months of age, 50% of the children at every month included /d/ in their repertoires. Both /m/ and /b/ were observed at five of the nine ages. The remaining consonants observed were also part of the low frequency group noted earlier.

A growth in mean number of consonants controlled occurs from 8 to 10 months, going from one observed phone /h/ at 8 months to three and six consonants appearing at 9 and 10 months respectively. One also begins to see the beginning of the single overall trend indicated in the data, i.e., a tendency for children to produce voiced, front consonants. The exceptions are /g/ at 10, 14, 15, and 16 months and /p/ at 16 months. At 10 months, as previously mentioned, the glide /w/ appears in repertoires, gliding off the visible front vowel /u/. This tendency is the opposite of that found during early infancy when back or velar sounds predominate.

By 11 months, the burgeoning repertoire seems to diminish to at least the 9-month level with /m/, /g/ and /w/ no longer represented in the data. At 12 months, the /b/, /g/ and /w/ have dropped from the group of sounds observed

while 13 months brings a further decrease in number to two phonetic units present as the /h/ no longer appears. These observed changes, however, fail to indicate a signicant non-linear trend. One should continue to note, however, that the production of voiced, front sounds still predominates.

A renewed growth or increase in consistently appearing consonants begins at 14 months as /h/, /g/ and /w/ reappear and it continues through to the achievement at 15 and 16 months of seven sounds. At 15 months, another voiced, front sound /n/ appears and another glide sound /j/ is consistently produced, gliding off the high, front vowel /i/.

At 16 months, while there is still a predominance of voiced, front sounds, the appearance of the first unvoiced segment /p/ consistently produced is noted.

DISCUSSION:

The major trend observed in the study was consistency in the place and voicing features of articulation of the majority of consonant sounds first exhibited in the 8 to 16 month age range. However, there were individual differences in the selection of which voiced, front sound characteristics were used and broad differences were evident in the manner of production. Even less consistency is apparent in the choice of low frequency consonants. The lack of a consistent order of acquisition of consonants is probably due to individual

differences in language environment and other variables.

The major previous studies to which the present data can be compared were those conducted by Irwin and Chen (1946, 1947a, and 1947b) and Chen (1946). The best description of the data base from which these studies were drawn is provided in Irwin (1946). In some ways, these data were comparable to ours although the research procedures were considerably different, in particular involving live transcription rather than audio or videotape. Despite these differences, remarkable consistency in results is apparent.

In the Irwin and Chen studies, ninety-five infants were observed several times in the age range of one to thirty months in what was apparently a mixed cross-sectional and longitudinal design. For the age range comparable to the present study, the number of subjects at each month-age ranged from 55 to 64. Rather than a consistent sampling time period, Irwin and Chen transcribed the sounds uttered on thirty breaths which they termed a "record". Varying numbers of records comprised the sample analyzed at each age. In the age range of 8 to 16 months, the number of records per age ranged from 127-170. Irwin (1947a) reported consonant phoneme percentages in a manner which allows comparison with our data, although their criteria for inclusion of a given consonant was considerably more liberal than ours. Table 4 lists in rank order the most frequent segments at each age. Only consonants with percent of occurrence less than 2% are omitted from the list. In comparing the Irwin high frequency

list (Table 4) with our own (Table 3), remarkable consistency is apparent. The phones which appear on Irwin's list but not on our list at the same age range are marked with an asterisk. It is important to remember that there were basic methodological differences between the studies. In particular, Irwin and Chan analyzed percentage of "records" at each age which contained at least one instance of a given consonant. In contrast we credit the child with control of a consonant only if it appears five times in a 30 minute taped session. However, there was still similarity in the emergent patterns observed.

In addition to the Irwin and Chen studies, there have been a few other studies that did detailed analysis of consonantal incidence (Blount, 1970; Cruttenden, 1970; Pierce, 1974). None of these reported the incidence or occurrence of any consonants that were not listed on our most frequent list although direct comparisons by age were not possible. All of these studies indicated the existence of a broader repertoire of segments than our data indicate; however, it must be kept in mind that the data we reported were constrained by competence criteria both at the individual subject level as well as at the specific age level.

Blount did not describe his sample of four children and he gave his children credit for single occurrences of sounds; therefore, the relevance of his findings to ours is marginal.

A closer correspondence is observed in comparing our research with that of Pierce. Again, the sound segments

reported by Pierce to occur at 9 and 12 months represent a total overlap with our most frequent list. Pierce set a consonant competence criterion of at least one occurrence in the repertoire of every child in his sample of 50 children. At nine months, he reported /h/ competently controlled or productive along with the addition of five consonants selected from /n, g, d, m, j, b, k, ʍ, β, ð/. The twelve-month Pierce data reported the single occurrence in each of the consonant systems of his fifty children of the following segments: /ʔ, h, m, b, j, w, d, g/ with two additional consonants selected from /β, n, ŋ, t, k, l, v/. While Pierce found a larger selection of consonants than our data at each age, this is again probably due to his use of incidence rather than competence as the criterion for inclusion in the typical consonantal repertoire.

Cruttenden studied the phonetic characteristics of babbling as they developed in his twin daughters. He made monthly tape recordings of about two hours of each twin from birth up to the age of 15 months. He found that during the early part of the period of 7 to 10 months, the /h/ sound predominated and that by about 14 to 15 months, /b, d, g, m, n, l/ accounted for a large part of the girls' phonetic repertoires.

In addition to phonetic analysis of babbling, several investigators have recently examined the phonetic and/or phonemic characteristics of a child's early lexicon in search of evidence for the continuity hypothesis linking babbling to

early language (Carter, 1979; Leonard et al., 1980; Oller et al., 1976; Vihman, in press). Carter has studied the appearance of consistent phonetic elements in the repertoire of one child as they related to the development of prelinguistic pragmatic schemata. Her observations, based on some of the ten one-hour tape recordings made during the course of the child's second year, reported the following consonantal segments accompanying identified pragmatic intentional gestures between the ages of 12 and 16 months: /d, h, b, m, n, j/.

Leonard et al reported on three studies of children's use of consonants during the early period of phonological development. All of his data reflect the use of initial consonants in words. Although our study began too early to begin to distinguish words from babbled utterances and did not consider sound position in the children's vocalizations, there is once again consistent agreement with Leonard's findings that early phonology consists mainly of bilabial stops, nasals and glides, alveolar stops and nasals, velar stops, as well as /h/. In addition, the phonemes which he reported as either infrequent or non-existent in young children's repertoires agree with our findings.

Oller et al also examined phonological development in early lexicon and reported the existence of early phonological simplification processes. Although their study does not cite specific consonantal incidence information for comparison, we find that our data are able to support their

general conclusions.

CONCLUSIONS:

Babbling and its role in phonological development have been historically controversial; however, recent study of prelinguistic vocalizations has demonstrated that babbling is not random, appears to follow a progression, reflects an emerging capacity for speech, and is an important precursor to or early aspect of phonological development. It is, therefore, crucial that we continue our examination of this significant phenomenon.

While the present study has reported an analysis of cross-sectional data which indicates a preference for front, voiced consonantal segments in the phonetic repertoires of 54 infants between the ages of 8 and 16 months of age, it has only begun to scratch the surface of what these early phone repertoires can tell us. Our research team is currently examining our cross-sectional and longitudinal (not reported here) data in order to observe and analyze the multi-faceted characteristics of these early phonetic repertoires and to, therefore, address this lesser known period of early babbling.

It appears that there is a link between the period of late babbling and early lexicon and several studies have alluded to a cognitive-linguistic relationship between these two periods (Oller et al, 1976; Vihman, in press). Yet to be

studied and uncovered is a common ground or purpose which links the period of early babbling to late babbling. The data reported here indicate at least a mechanical link between these two periods.

It appears that these is a link between the period of late babbling and early lexicon and several studies have alluded to a cognitive-linguistic relationship between these two periods (Oller et al., 1976; Vihman, in press). Yet to be studied and uncovered is a common ground or purpose which links the period of early babbling to late babbling. The data reported here indicate at least a mechanical link between these two periods which would have far-ranging implications for clinical assessment and intervention with high-risk infants. Both McCarthy (1952) and Glazewski (1982) discuss the anatomical, physiological and neurological influences and substrates of early phonological development in terms of organismic theory. While there remains a considerable amount of observation to be done in this area, the appearance of general trends in our data indicate some sort of constraints on a child's early phonological capacity. The early phone repertoires reported here are quite consistent and predictable when compared to the breadth and variety of later ones. Our data lend, therfore, not only empirical support to Irwin and Chen's consonantal incidence reports, but they also strongly support a more theoretical, organismic interpretation of early babbling in terms of such anatomical, physiological and neurological constraints on the

oral-peripheral mechanism as size, shape, capacity and control of the mechanism, position and placement of valving and contact points, development or maturation of flexibility and control of articulators, appearance of dentition, gravitational forces, postural influences, and developmental changes in the plurality of function of muscles involved in life-sustaining functions. These biological phenomena appear to dictate not only which consonantal segments appear in the phonetic repertoires of a child during the early phases of phonolofical development, but also which elements do not appear. This information also has clinical ramifications as, at least from the existing data, it appears that those sounds not observed at early ages are the very ones which are problematic in later phonology (e.g., /θ, ð, l, r, z, v/). The notion of phonological development as a continuous process of interdependent stages, all of which are a direct result of what is occurring and has occurred to the oral-peripheral speech mechanism needs to be examined more closely.

Table 1

Consonant Competence

(months)

	8	9	10	11	12	13	14	15	16	Total
d	2	3	5	3	3	5	6	5	4	36
h	4	5	5	4	3	2	4	3	3	33
m	1	2	3		3	5	1	4	5	24
b	1	4	3	3	1	2	2	3	4	23
g	1	2	4	2	1	2	3	4	3	22
w		1	3	2	2	2	4	2	2	18
j	1	1	1	1	2	2	3	4	2	17
n	1	2	1	2	1	2	1	3	4	17
r	1		2		1			1	2	7
ʃ				1	1			2	2	6
t				1			2	1	2	6
p			1	1					3	5
k		1	1				2		1	5
l		1		1	1	1			1	5
s				1			1	1	1	4
ʒ									2	2
z								1	1	2
v									1	1
f										0
										0
										0
(mean)	2	3.7	4.8	3.7	3.2	3.8	4.8	6.8	7.2	

Table 2

	Voicing	Place	Manner
/d/	V	F	S
/h/	U	B	C
/b/	V	F	S
/m/	V	F	NC
/g/	V	B	S
/w/	V	Glides off Front Vowel	G
/j/	V	"	G
/n/	V	F	NC

Key:

U --unvoiced

V --voiced

F --Front

B --Back

S --Stop

C --Continuant

G --Glide

NC--Nasal Continuant

Table 3

Consonants Achieved

(Evidence of 3 Occurrences at an age)

Age in Months		Total # of Consonants per Month
8	- h	1
9	d h - b	3
10	d h m b g w	6
11	d h - b	3
12	d h m	2
13	d - m	4
14	d h - - g w	4
15	d h m b g - /j/ n	7
16	d h m b g - - - n - - p	7

Table 4

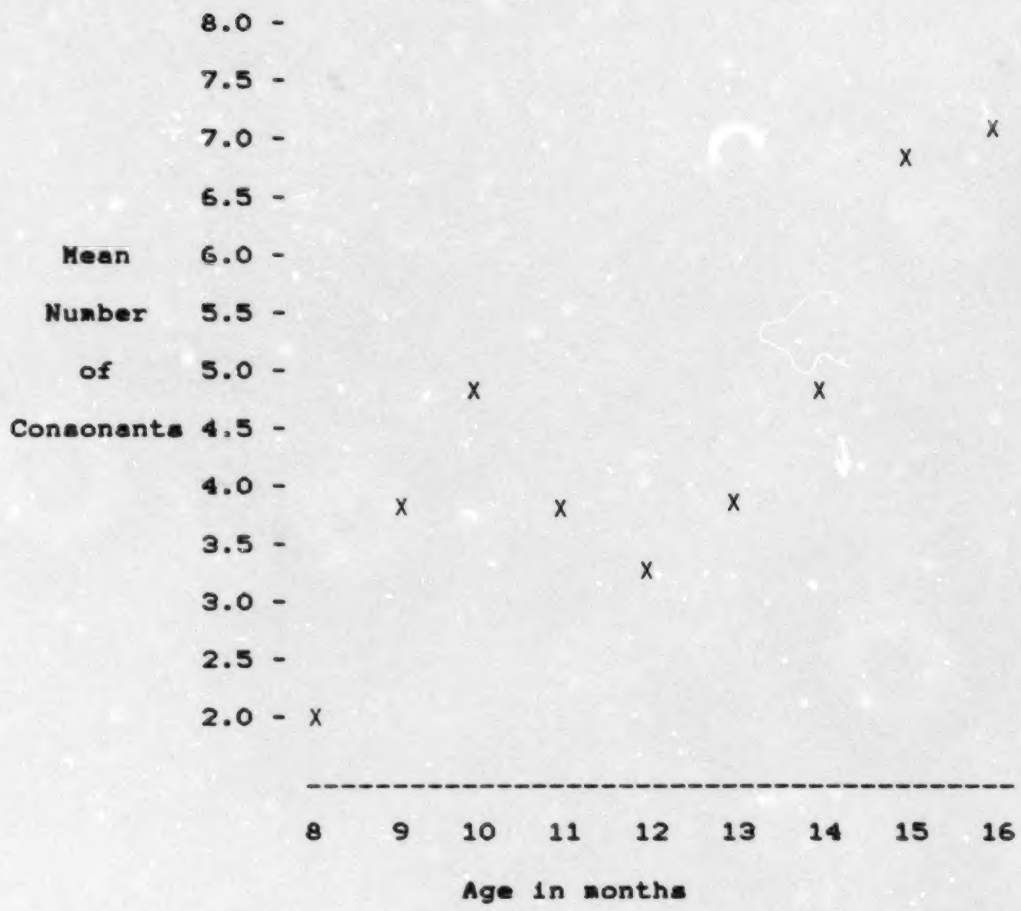
Rank within each age range (Irwin and Chen)

	7-8	9-10	11-12	13-14	15-16
1	h 57.87	h 41.29	h 31.77	h 29.75	h 26.69
2	? 8.51*	d 15.73	d 20.58	d 19.42	d 20.04
3	d 6.46*	b 7.97	b 9.79	b 9.48*	b 11.95
4	g 5.43*	m 7.53	m 6.69	m 9.23	m 5.74
5	m 5.21*	z 5.21*	t 4.34*	g 4.91*	g 5.55
6	b 4.47*	g 4.12	g 4.15*	w 4.36*	w 4.55*
7	k 2.05*	w 2.64	s 3.45*	t 3.96*	t 4.14*
8			w 3.31*	j 3.78*	n 3.11
9			n 2.65*	s 2.81*	s 3.08*
10				k 2.36*	k 2.76*
11			? 2.52*	? 2.31*	p 2.10
12			k 2.12*	n 2.07*	

* Not on our list

? = glottal

Figure 1


8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
Mean Number of Consonants
8 9 10 11 12 13 14 15 16
Age in months

BIBLIOGRAPHY

Bayley, N. (1969). Manual for the Bayley scales of infant development. New York: the Psychological Corporation.

Bloom, L. (1970). Language development: form and function in emerging grammars. Cambridge, Ma.: M.I.T. Press.

Blount, B. G. (1970). The pre-linguistic system of Luo Children. Anthropological Linguistics, 12, 326-343.

Buhr, R. D. (1980). The emergence of vowels in an infant. Journal of Speech and Hearing Research, 23, 73-94.

Carter, A. L. (1979). Prespeech meaning relations: an outline of one infant's sensorimotor morpheme development. In P. Fletcher and M. Garman (Eds.), Language Acquisition: studies in first language development. Cambridge: Cambridge University Press.

Chen, Han P. (1946). Speech development during the first year of life. Unpublished doctoral dissertation, University of Iowa.

Cruttenden, A. (1970). A phonetic study of babbling. British Journal of Disorders of Communication, 5, 110-118.

De Boysson-Bardies, B., Sagart, L. and Bacri, N. (1982). Phonetic analysis of late babbling: a case study of a French child. Journal of Child Language, 8, 511-524.

Ferguson, C. and Farwell, C. (1975). Words and sounds in early language acquisition: English initial consonants in the first 50 words. Language, 51, 419-439.

Ferguson, C. and Macken, M. A. (in press). The role of play in phonological development. In K. Nelson (Ed.), Child Language IV. New York: Gardner Press.

Gilbert, H. R. and Zawadski, P. (1982). A longitudinal study of infant vocalizations: the first two years. Paper presented at ASHA Convention, Toronto, 1982.

Glazewski, B. K. (1982). Phonological development during the first year: Implications for intervention. Seminars in Speech, Language and Hearing, 3, 196-201.

Humphreys, M. W. (1880). A contribution to infantile linguistics. Transcript of the American Philological Association, 11, 5-17.

Ingram, D. (1975). Current issues in child phonology. In D. M. Morehead and A. E. Morehead (Eds.), Normal and Deficient Child Language. Baltimore: University Park Press.

Ingram, D. (1974). Phonological rules in young children. Journal of Child Language, 1, 49-64.

Irwin, O. C. (1947). Infant speech: consonantal sounds according to place of articulation. Journal of Speech and Hearing Disorders, 12, 397-401.

Jakobson, R. (1941/1968). Child language, aphasia, and phonological universals. The Hague: Mouton.

Kent, R. D. & Murray, A. D. (1982). Acoustic features of infant vocalic utterances at 3, 6, and 9 months. Journal of the Acoustical Society of America, 72, 353-365.

Leonard, L. B., Newhoff, M., & Mesalam, L. (1980). Individual differences in early child phonology. Applied Psycholinguistics, 7-30.

Leopold, W. (1947). Speech development of a bilingual child: A linguist's record. Sound learning in the first two years (Vol. 2). Evanston, Il.: Northwestern University Press.

Lewis, M. (1936). Infant speech: a study of the beginnings of language. London: Kegan Paul.

Ling, D. and Ling, A. (1974). Communication development in the first three years of life. Journal of Speech and Hearing Research, 17, 146-159.

Locke, J. L. (1983). Phonological Acquisition and Change. New York: Academic Press.

cCarthy, D. (1952). Organismic interpretation of infant vocalizations. Child Development, 23, 273-280.

McCarthy, D. (1954). Language development in children. In L. Carmichael (Ed.), Manual of Child Psychology. New York: Wiley, 492-630.

Nakazima, S. (1975). Phonemicization and symbolization in language development. In Lenneberg and Lenneberg (Eds.), Phonemicization and symbolization in language development (Vol. 1). New York: Academic Press.

Nakazima, S. (1980). The reorganization process of babbling. In Murry and Murry (Eds.), Infant communication: cry and early speech. Houston: College-Hill Press.

Oller, D. K. (1980). The emergence of the sounds of speech in infancy. In G. H. Yeni-Komshian, J. F. Kavanagh and C.

A. Ferguson, Child Phonology, Volume 1: Production. New York: Academic Press.

Oller, D., Wieman, L., Doyle, W. and Ross, C. (1976). Infant babbling and speech. Journal of Child Language, 3, 1-11.

Pierce, J. E. (1974). A study of 750 Portland, Oregon children during the first year. Papers and Reports on Child Language Development, Stanford University, 8, 19-25.

Poole, I. (1934). Genetic development of articulation of consonant sounds in speech. Elementary English Review, 11, 159-161.

Roe, Kiki V. (1975). Amount of infant vocalization as a function of age: some cognitive implications. Child Development, 46, 936-941.

Smith, N. (1973). The acquisition of phonology: a case study. Cambridge, Ma.: Cambridge University Press.

Smith, B. L. and Oller, D. K. (1981). A comparative study of pre-meaningful vocalizations produced by normally developing and Down's Syndrome infants. Journal of Speech and Hearing Disorders, 46, 46-51.

Stark, R. E. (1980). Stages of speech development in the first year of life. In G. H. Yeni-Komshian, J. F. Kavanagh and C. A. Ferguson, Child Phonology, Volume 1: Production. New York: Academic Press.

Stark, R. E., Heinz, J. M. and Wright-Wilson, C. (1976). Vowel utterances of young infants. Journal of the Acoustical Society of America, 60, 543.

Templin, M. (1957). Certain language skills in children: their development and interrelationships. Institute of Child Welfare Monograph, 26. Minneapolis: the University of Minnesota Press.

Velten, H. (1943). The growth of phonemic and lexical patterns in infant language. Language, 19, 281-292.

Vihman, M. Macken, M. A., Miller, R., Simmons, H., and Miller, J. (in press). From babbling to speech: A reassessment of the continuity issue.

Vihman, M. (1976). From pre-speech to speech: On early phonology. Papers & Reports on Child Language Development (Linguistics, Stanford University), 12, 230-243.

Waterson, N. (1971). Child phonology: a prosodic view. Journal of Linguistics, 7, 170-221.

Wellman, B., Case, I., Mengert, I. and Bradbury, D. (1931). Speech sounds of young children. University of Iowa Studies in Child Welfare, No. 5.

Winitz, H. (1969). Articulatory acquisition and behavior. New York: Appleton-Century Crofts.

Yeni-Komshian, G. H., Kavanagh, J. F. and Ferguson, C. A. (Eds.). (1980). Child Phonology: Volume 1, Production. New York: Academic Press.